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Isoëtes todaroana (Isoëtaceae, Lycopodiophyta), a New Species from Sicily (Italy)

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ABSTRACT.—*Isoëtes todaroana*, a new species from western Sicily (Italy), is described. Morphological, anatomical and ecological characters are given. The main differential characters are the presence of only two leaf air chambers, rather than four as in all other known species of the genus, and the shape of the scales, which have two lateral rounded lobes and one central spine-like lobe, together with its peculiar calcophilic habitat. So far, the species is known from a single locality.

KEY WORDS.—Lycopodiophyta, Isoëtaceae, *Isoëtes*, Mediterranean area, Italy, Sicily

Four species of *Isoëtes* have been previously reported from Sicily (Troia, 2005): *Isoëtes histrix* Bory, *I. sicula* Tod. [= *I. subinermis* (Bory) Cesca & Peruzzi, =? *I. gymnocarpa* (Gennari) A. Braun], *I. velata* A. Braun, and *I. duriei* Bory. All of these grow on seasonally wet, siliceous soils, except for *I. velata* which colonizes temporary ponds.

Over the last ten years, field, herbarium, and laboratory studies have been conducted by one of us on the genus *Isoëtes* (e.g., Romeo *et al.*, 2000; Troia and Bellini, 2001; Troia, 2005). As part of these studies, a population of *Isoëtes* was located in a wetland near Mazara del Vallo, Western Sicily. Closer inspection of the specimens showed that they differed in several aspects from the other species occurring on the island. Analyses of living and dried plants confirmed that this population represents a unique and previously undescribed species of *Isoëtes*, which is here named and described. For description and nomenclature of megaspores and microspores we followed Hickey (1986) and Musselman (2003), respectively.

Isoëtes todaroana Troia & Raimondo, ***sp. nov.*** TYPE.—ITALY. Sicily: contrada "Critazzo" near Mazara del Vallo, 37°41′07″N, 12°37′05″E, *ca.* 60 m a.s.l., 10 Apr. 2009, *Angelo Troia* (holotype: PAL; isotypes: PAL, FI). **Figs. 1–10**.

Herba perennis amphibia, emergens aut submersa. Cormus trilobus, radicibus dichotomis. Folia 15–30 (−40), erecta vel patentia, 3–6 (−14) cm longa, inferne brevi tractu anguste alato-membranacea, basi usque 3–4 mm, in medio circa 1 mm lata. Duae magnae lacunae et 1–3 fasciculi fibrarum periphaerici (collenchymatosi) in trasversali sectione. Stomata elliptica, 37–70 μm longa, 24–32 μm lata, in facie abaxiali tantum obvia. Velum sporangium

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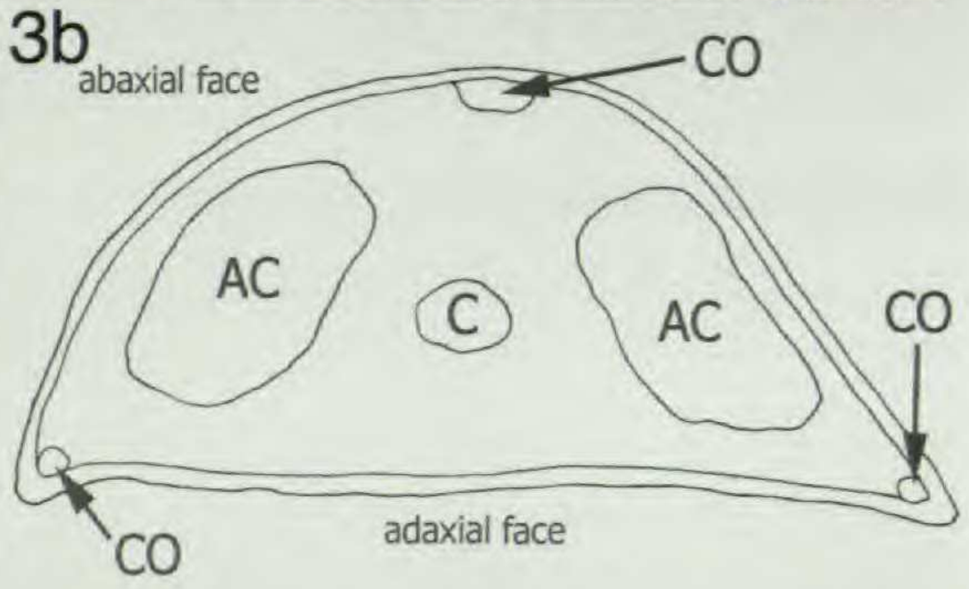
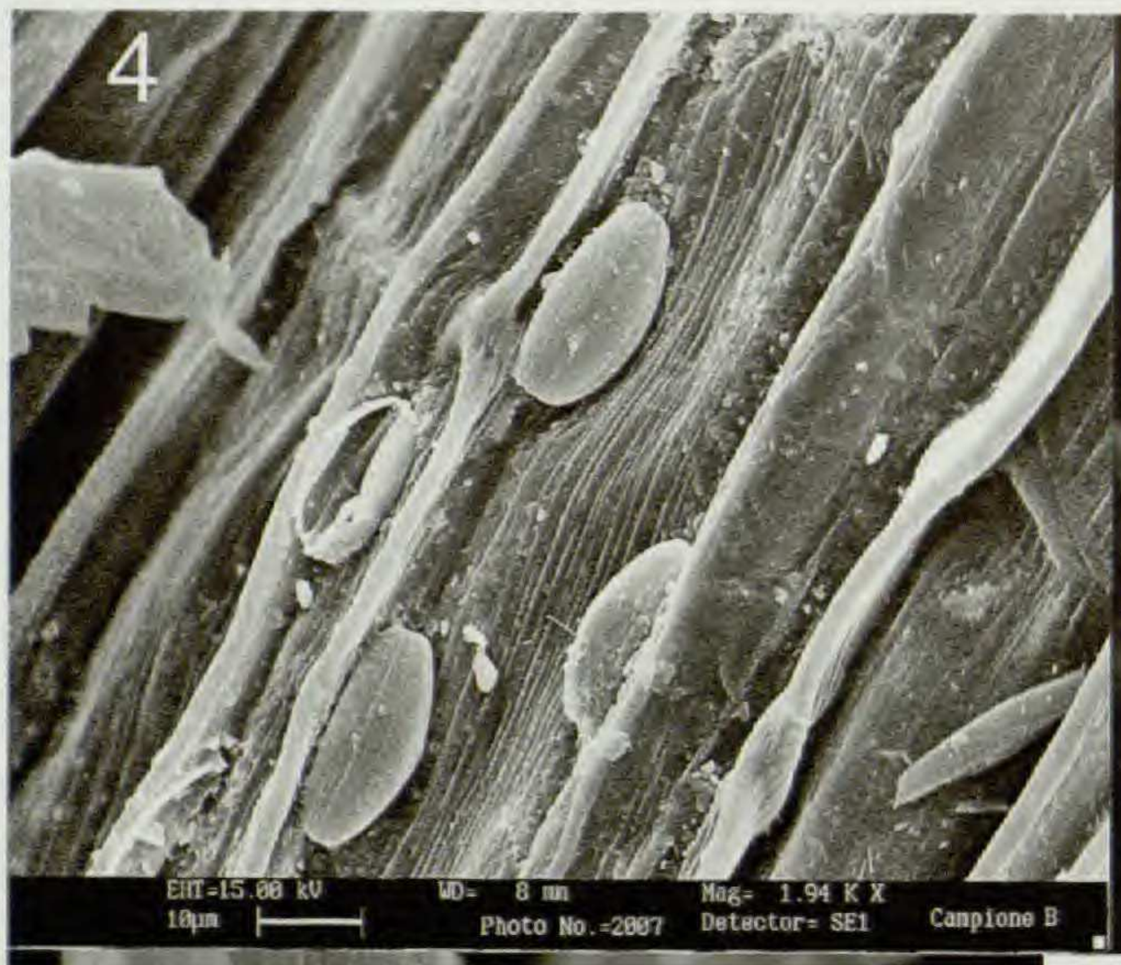
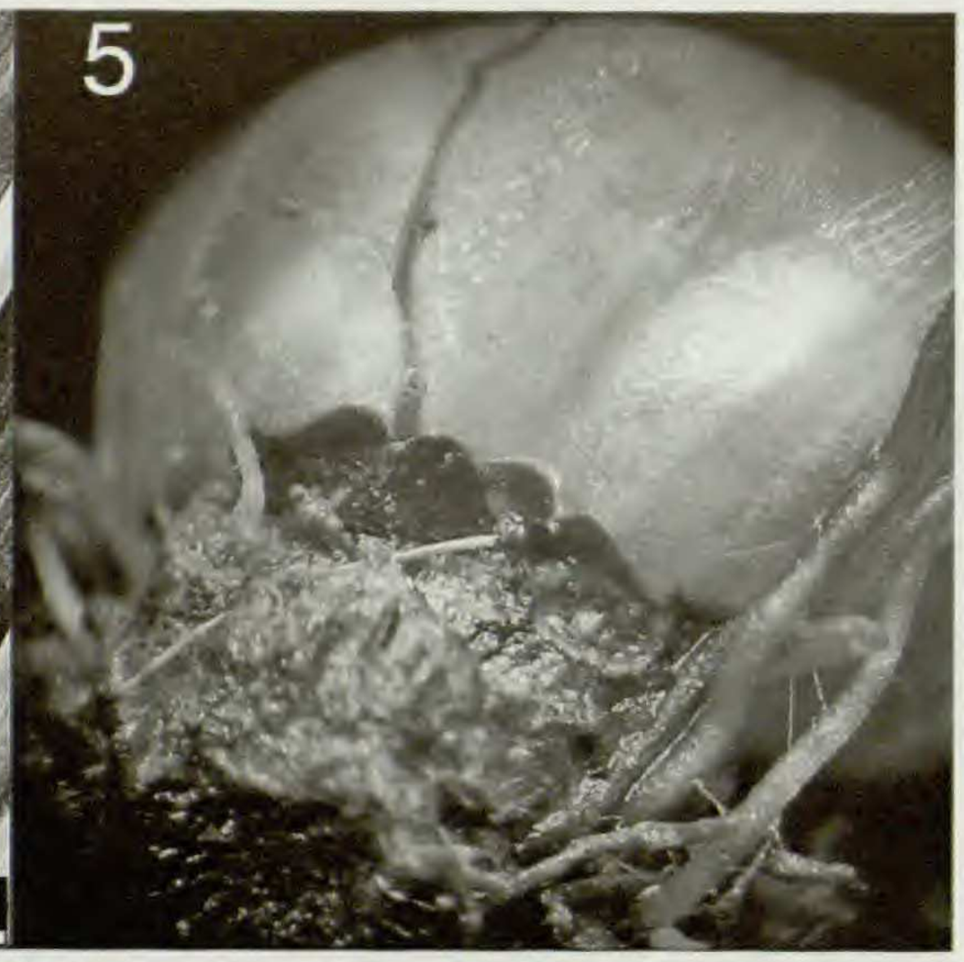


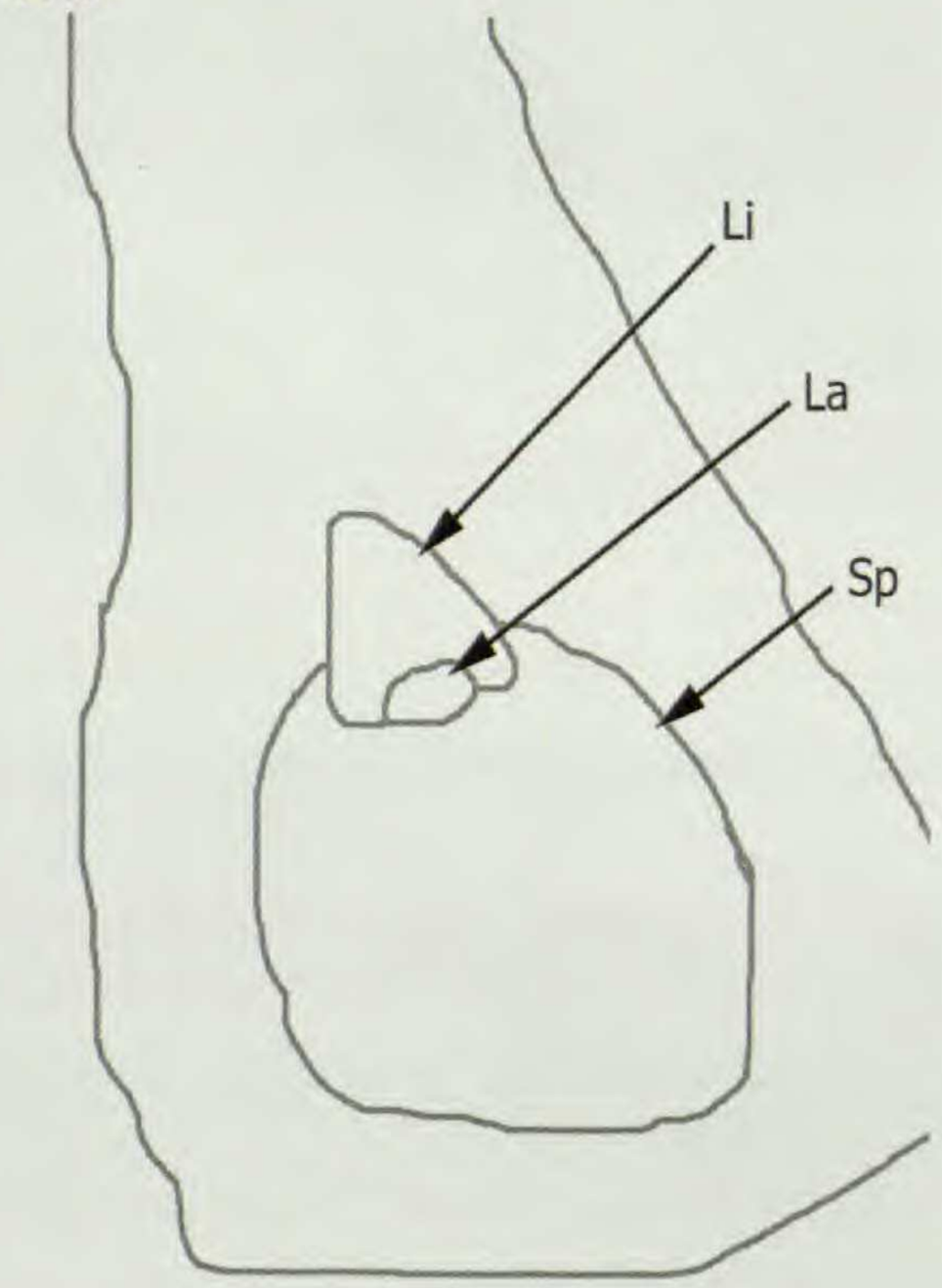
FIGS. 1–3. Morphological and anatomical traits of *I. todaroana*. 1–2. Plants in their habitat (the coin is *ca.* 18 mm in diameter). 3 (a/b). Transverse section of the leaf: AC = air chambers (the one on the left partially covered by the translacunar diaphragm); CO = collenchymatous strands; C = vascular bundle (with at least one intrastelar canal).

obtegens. Ligula membranacea, lanceolata, basi auriculata. Labium breve. Squamae paucae, coriaceae, nigrescentes, lobis lateralibus rotundatis et dente medio aciculari. Macrosporae candidae, sphaeroideae, 420–460 µm, annulo horizontali cinctae, hemispherio superiore tricostatae, undique tuberculatae. Microsporae ovatae, *ca.* 25 µm longae, aculeatae. Habitat in humidis hyeme inundatis.

Plants amphibious, emergent or submerged in temporary ponds, losing their leaves in the dry summer season. Stem (corm) trilobate, with dichotomous roots. Leaves 15–30(−40), patent to erect, narrowly lanceolate, 3–6 (−14) cm long, 3–4 mm wide at base, *ca.* 1 mm wide at mid-length. Alae proximally hyaline or transluscent, *ca.*1 mm wide at the sporangium, gradually narrowing distally. Subula semiterete, adaxially flat, abaxially convex. Leaf epidermis with cuticular ornamentation, "cuticular pegs" (sensu Prada and Rolleri, 2005, = "cuñas cuticulares" sensu Rolleri and Prada, 2007) well developed, evident as continuous longitudinal ridges. Stomatal complexes in rows, elliptic, 37–70 µm long, 24–32 µm wide, confined to the abaxial surface. Hypodermal collenchymatous bands one to three, the two marginal bands sometimes absent. Air chambers two, with translacunar diaphragms. Velum complete. Ligule *ca.* 1 mm long, membranaceous, broadly lanceolate, auriculate at base.

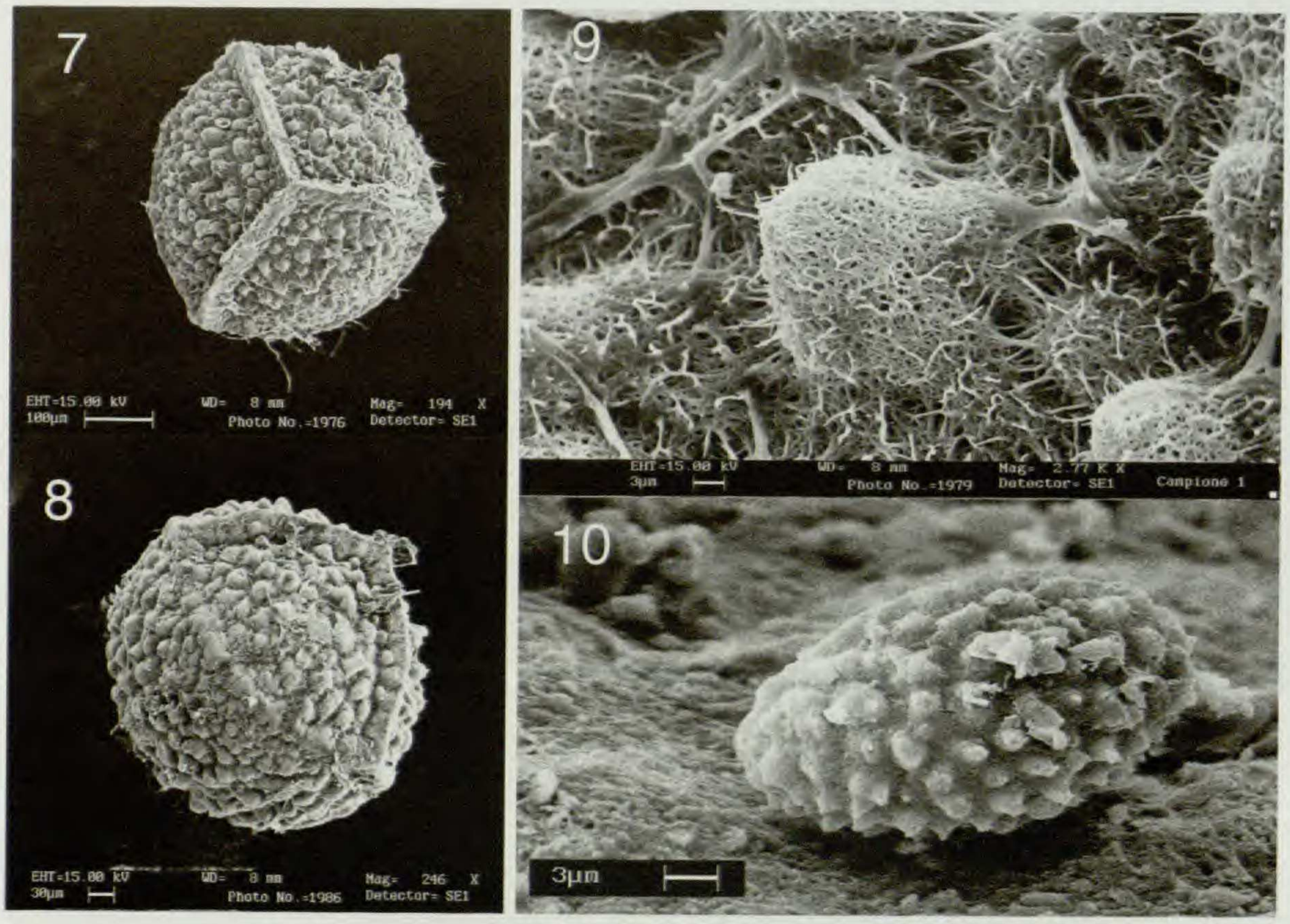






FIGS. 4–6. Morphological and anatomical traits of *I. todaroana*. 4. Surface view of the leaf epidermal cells. Note the cuticular ornamentation, the cuticular pegs well developed, evident as continuous longitudinal ridges, and the epiphytic diatoms. 5. Scales. 6 (a/b). Adaxial face of the leaf base: Li = ligula; La = labium; Sp = (mega)sporangium.

Labium shorter than ligule. Scales few, black, with two lateral rounded lobes and one (usually short) central spine-like lobe. Megaspores 420–460 µm in diameter, white, subtriangular in polar view, tuberculate. Microspores *ca.* 25 µm long, aculeate.



FIGS. 7–10. SEM images of *I. todaroana* megaspores and microspores. 7. Proximal view of megaspore. 8. Equatorial view of megaspore. 9. Megaspore (detail of a single tubercle). 10. Distal view of microspore.

ETYMOLOGY.—This new species is dedicated to the Sicilian botanist Agostino Todaro (1818–1892), in recognition of his contribution to the pteridological flora of Sicily.

ECOLOGY.—The type locality is a temporary wetland that dries out during the summer. It is a remnant of a wider wetland that has been "reclaimed" and converted to farming land that surrounds and encloses the type locality. The natural vegetation, although altered, is well represented with a mosaic of communities, with species such as *Bolboschoenus maritimus* (L.) Palla, *Eleocharis palustris* (L.) Roem. & Schult., *Scirpus cernuus* Vahl, *Mentha pulegium* L., *Oenanthe* sp., *Lythrum* sp., *Tamarix* sp., *Romulea* sp., etc. The wetland hosts the last remnants of a peculiar freshwater invertebrate fauna; a preliminary investigation has led, for example, to the discovery of a small population of the notostracan *Lepidurus apus lubbocki* (Crustacea), a "living fossil" that was considered extinct in Sicily (F. Marrone, pers. comm.).

The wetland exists on a peculiar geological substrate of calcareous sandstones with a thin layer of clays on top (hence the local name, "Critazzo", which in Sicilian dialect refers to clays). The soil pH around the *Isoëtes* (determined electrometrically with two replicates from 20 g of soil and measured in distilled water with a dilution ratio of 1: 2.5) was found to be

basic, 8.5–8.9. As far as we know, the other species occurring in Sicily consistently grow on acid soils, so that this site, although geologically complex, is unusual, a fact that deserves further investigations.

DISTRIBUTION.—*Isoëtes todaroana* is only known so far from the *locus classicus*, in an area of about 200 × 100 m. It is possible that other populations may be found in the future, in Sicily and elsewhere in the Mediterranean area.

CONSERVATION STATUS.—The single known population is threatened by farming and other human activities (waste dumping, land reclamation, summer fires, etc.). On the basis of the current "IUCN Red List Categories and Criteria" (IUCN, 2001), the species is rated "Critically Endangered" [CR B1ab(iii)].

Urgent measures are needed to protect the site; considering that it is practically unexplored, it is possible that other rare or endangered species are present, in addition to *Isoëtes todaroana* and *Lepidurus apus lubbocki* already mentioned. However, it is clear that it is a strategic area for migrating birds and it hosts communities that can be referred to the habitat "Mediterranean temporary pond", considered a "priority" habitat by the Council of the European Communities 92/43/EEC Directive. Our proposal is to include the site, currently not protected, inside the adjacent "Site of Community Interest" code ITA010014, established to protect habitat and species according to the mentioned Directive. Since this inclusion will not be made in a short time and will not automatically guarantee the protection of species and habitats, we also suggest considering other actions (e.g., agreements with the owners, territory planning restrictions, land purchase) as soon as possible.

TAXONOMIC OBSERVATIONS.—The shape of the scales, and particularly the presence of only two leaf air chambers rather than four as in all other species of the genus (Rolleri and Prada, 2007), are the main differentiating characters of this species. Its systematic relationships are difficult to assess merely on the basis of anatomy and morphology, owing to parallel and convergent morphological evolution in the genus (Hickey, 1986; Hoot *et al.*, 2006; Bolin *et al.*, 2008). The presence of scales, sometimes transitioning into phyllopodia, and collenchymatous strands suggests a link between this species and the Mediterranean "terrestrial" taxa, and the megaspore ornamentation, in particular, vaguely suggests a connection with *I. histrix* and *I. sicula*. However, as shown by Bolin *et al.* (2008), the latter two species, although morphologically similar, are not immediately related. On the other hand, the fibrillose megaspore surface background (Fig. 9) suggests a relationship with other species, e.g., the amphibious *Isoëtes velata*.

Further studies are in progress to add to the knowledge of the new species and shed light on its relationships.

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